NRCS
Natural
Resources
Conservation
Service

United States Department of Agriculture

Washington
Water Supply Outlook Report
June 1, 2002

Washington SNOTEL Sites

Water Supply Outlook Reports
and
Federal - State – Private Cooperative Snow Surveys

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How forecasts are made

Most of the annual streamflow in the western United States originates as snowfall that has accumulated in the mountains during the winter and early spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when it melts. Measurements of snow water equivalent at selected manual snow courses and automated SNOTEL sites, along with precipitation, antecedent streamflow, and indices of the El Niño / Southern Oscillation are used in computerized statistical and simulation models to prepare runoff forecasts. These forecasts are coordinated between hydrologists in the Natural Resources Conservation Service and the National Weather Service. Unless otherwise specified, all forecasts are for flows that would occur naturally without any upstream influences.

Forecasts of any kind, of course, are not perfect. Streamflow forecast uncertainty arises from three primary sources: (1) uncertain knowledge of future weather conditions, (2) uncertainty in the forecasting procedure, and (3) errors in the data. The forecast, therefore, must be interpreted not as a single value but rather as a range of values with specific probabilities of occurrence. The middle of the range is expressed by the 50% exceedance probability forecast, for which there is a 50% chance that the actual flow will be above, and a 50% chance that the actual flow will be below, this value. To describe the expected range around this 50% value, four other forecasts are provided, two smaller values (90% and 70% exceedance probability) and two larger values (30%, and 10% exceedance probability). For example, there is a 90% chance that the actual flow will be more than the 90% exceedance probability forecast. The others can be interpreted similarly.

The wider the spread among these values, the more uncertain the forecast. As the season progresses, forecasts become more accurate, primarily because a greater portion of the future weather conditions become known; this is reflected by a narrowing of the range around the 50% exceedance probability forecast. Users should take this uncertainty into consideration when making operational decisions by selecting forecasts corresponding to the level of risk they are willing to assume about the amount of water to be expected. If users anticipate receiving a lesser supply of water, or if they wish to increase their chances of having an adequate supply of water for their operations, they may want to base their decisions on the 90% or 70% exceedance probability forecasts, or something in between. On the other hand, if users are concerned about receiving too much water (for example, threat of flooding), they may want to base their decisions on the 30% or 10% exceedance probability forecasts, or something in between. Regardless of the forecast value users choose for operations, they should be prepared to deal with either more or less water. (Users should remember that even if the 90% exceedance probability forecast is used, there is still a 10% chance of receiving less than this amount.) By using the exceedance probability information, users can easily determine the chances of receiving more or less water.

Washington
Water Supply Outlook

June 2002

General Outlook

Once again, below average temperatures during the month of May slowed normal snowmelt. Near average precipitation and even a little fresh snow helped to hold snowpack in place. The slow melt, combined with already above average snowpack, makes for impressive percents of average in basins such as the Cedar River. Readers should be cautious of using percent of normal as a true indicator of current conditions. The most important factor is the calculation of snow water content as contributing to runoff. An annual report of Glacier contribution to runoff, as contributed by the North Cascades Glacier Monitoring Program, can be found at the back of this publication. According to the Climate Prediction Center there is a chance of having above average temperatures and below average precipitation over the next 30-60 days. This is the last published report for the season so visit the snow survey web site for up to date information and links. http://www.wa.nrcs.usda.gov/snow

Snowpack

The June 1 statewide SNOTEL readings were above average at 172%. Approximately 20 of 56 SNOTEL sites had reported complete melt-out by June 1. Readings in the Cedar River Basin reported the highest at 534% of average. Westside averages from SNOTEL and June 1 snow surveys included the North Puget Sound river basins with 133% of average, the Central Puget river basins with 268% and the Lewis-Cowlitz basins with 184% of average. Snowpack along the east slopes of the Cascade Mountains included the Yakima and the Wenatchee areas with 160%. Snowpack in the Spokane River Basin was at 188% and the Walla Walla River Basin had 77% of average. Maximum snow water content in Washington was at Paradise Park SNOTEL near Mount Rainer, with water content of 84.6 inches. This site normally has 61.6 inches of water content on June 1.

BASIN	PERCENT OF LAST YEAR	PERCENT OF AVERAGE
Spokane	1245	188
Newman Lake	0	0
Pend Oreille	748	145
Okanogan	322	140
Methow	1776	123
Similkameen	0	0
Wenatchee	506	162
Chelan	493	159
Upper Yakima	662	193
Lower Yakima	478	127
Ahtanum Creek	0	83
Walla Walla	0	77
Lower Snake	0	128
Cowlitz	321	141
Lewis	1971	227
White	351	158
Green	938	261
Puyallup	351	158
Cedar	0	534
Snoqualmie	674	183
Skykomish	0	193
Skagit	529	145
Baker	347	132
Nooksack	0	121
Olympic Peninsula	0	411*

* Calculated average from Period Of Record (POR)

Precipitation

During the month of May, the National Weather Service and Natural Resources Conservation Service climate stations reported varied precipitation amounts throughout the state. The highest percent of average in the state was at Harts Pass SNOTEL, which reported 296% of average for a total of 7.9 inches. The average for this site is 2.7 inches for May. Basin averages for the water year remain near to above average with the Spokane area reporting the highest at 122% and the Walla Walla River Basin with the lowest at 99% of average.

RIVER BASIN	MAY PERCENT OF AVERAGE	WATER YEAR PERCENT OF AVERAGE
Spokane	124	122
Colville-Pend Oreille	109	117
Okanogan-Methow	117	108
Wenatchee-Chelan	90	116
Upper Yakima	88	108
Lower Yakima	92	106
Walla Walla	71	99
Lower Snake	68	106
Cowlitz-Lewis	73	108
White-Green-Puyallup	91	104
Central Puget Sound	106	115
North Puget Sound	110	120
Olympic Peninsula	88	117

Reservoir

Seasonal reservoir levels in Washington vary greatly due to specific watershed management practices required in preparation for irrigation season, fisheries management, power generation and flood control. Reservoir storage in the Yakima Basin was 742,000-acre feet, 102% of average for the Upper Reaches and 227,000-acre feet, 111% of average for Rimrock and Bumping Lakes. The power generation reservoirs included the following: Coeur d'Alene Lake, 437,000 acre feet, 162% of average and 183% of capacity; Chelan Lake, 374,000 acre feet, 79% of average and 55% of capacity; and the Skagit River reservoirs at 82% of average and 62% of capacity.

BASIN	PERCENT OF CAPACITY	CURRENT STORAGE AS PERCENT OF AVERAGE
Spokane	183	162
Colville-Pend Oreille	61	102
Okanogan-Methow	41	45
Wenatchee-Chelan	55	79
Upper Yakima	89	102
Lower Yakima	98	111
North Puget Sound	62	82

For more information contact your local Natural Resources Conservation Service office.

Streamflow

Streamflow forecasts for the June - September runoff period vary from 185% of average for the Rex River near Cedar Falls to 68% of average at the Grande Ronde at Troy, OR. Forecasts for some western Washington streams include the Lewis at Ariel, 130%; Green River, 128%; and Skagit River, 120%. Some eastern Washington streams include the Yakima River near Parker, 119%; Wenatchee River at Plain, 115%; and Spokane River near Post Falls, 145%. Volumetric forecasts are developed using current, historic and average snowpack, precipitation and streamflow data which is collected and coordinated by organizations cooperating with NRCS.

May streamflows were near average throughout the state. The Spokane River at Long Lake had the highest reported flows with 142% of average. The Snake River below Lower Granite Dam with 80% of average, was the lowest in the state. Other streamflow percent of averages: the Cowlitz, 109%; the Spokane at Spokane, 137%; the Columbia below Rock Island Dam, 93%; and the Cle Elum near Roslyn, 103%.

BASIN	PERCENT OF AVERAGE MOST PROBABLE FORECAST (50 PERCENT CHANCE OF EXCEEDENCE)
Spokane	138-145
Colville-Pend Oreille	83-111
Okanogan-Methow	95-123
Wenatchee-Chelan	101-122
Upper Yakima	121-151
Lower Yakima	105-133
Walla Walla	103
Lower Snake	68-121
Cowlitz-Lewis	114-130
White-Green-Puyallup	126-128
Central Puget Sound	128-185
North Puget Sound	116-121
Olympic Peninsula	112-114

STREAM	PERCENT OF AVERAGE MAY STREAMFLOWS
Pend Oreille below Box Canyon	95
Kettle at Laurier	81
Columbia at Birchbank	89
Spokane at Long Lake	142
Similkameen at Nighthawk	103
Okanogan at Tonasket	101
Methow at Pateros	83
Chelan at Chelan	92
Wenatchee at Pashastin	95
Yakima at Cle Elum	112
Yakima at Parker	110
Naches at Naches	106
Grande Ronde at Troy	85
Snake below Lower Granite Dam	80
SF Walla Walla near Milton Freewater	103
Columbia River at The Dalles	87
Lewis at Ariel	103
Cowlitz below Mayfield Dam	109
Skagit at Concrete	104

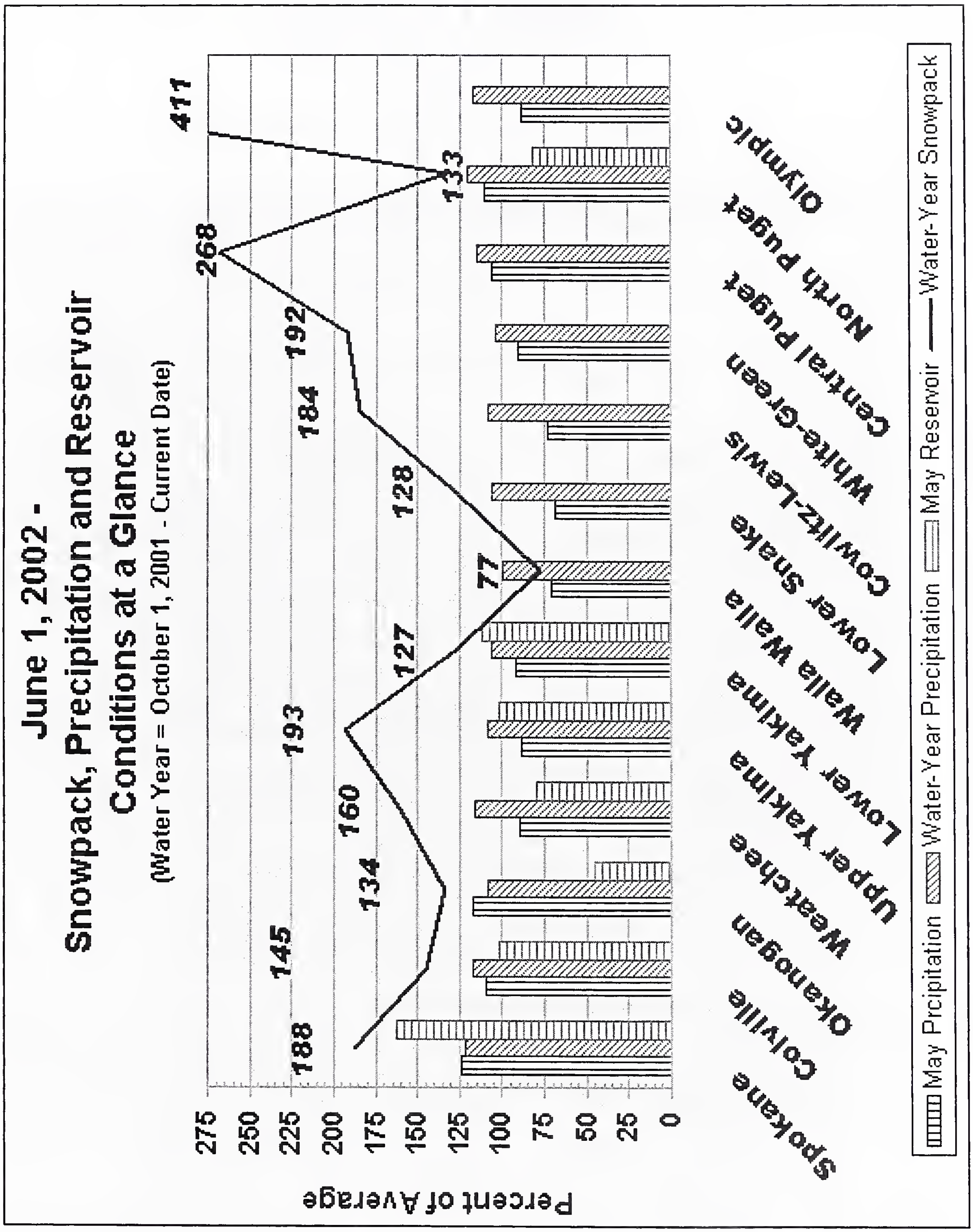
For more information contact your local Natural Resources Conservation Service office.

B A S I N S U M M A R Y O F
S N O W C O U R S E D A T A

JUNE 2002

SNOW COURSE	ELEVATION	DATE	SNOW DEPTH	WATER CONTENT	LAST YEAR	AVERAGE 1971-00
ALPINE MEADOWS	3500	6/01/02	---	37.0E	--	22.7
BADGER PASS SNOTEL	6900	6/01/02	---	37.8	8.9	22.9
BARKER LAKES SNOTEL	8250	6/01/02	---	7.2	.0	9.5
BASIN CREEK SNOTEL	7180	6/01/02	---	.0	.0	4.1
BASSOO PEAK	5150	6/03/02	0	.0	--	--
BEAVER CREEK TRAIL	2200	5/29/02	0	.0	.0	--
BEAVER PASS	3680	5/29/02	42	22.8	.0	17.8
BIG WHITE MTN CAN.	5510	6/02/02	23	10.6	1.7	7.6
BLACK PINE SNOTEL	7100	6/01/02	---	.0	.0	1.9
BLEWETT PASS#2SNOTEL	4270	6/01/02	0	.0	.0	.0
BROWN TOP AM	6000	5/29/02	151	73.6	21.6	52.0
BUMPING RIDGE SNOTEL	4600	6/01/02	---	10.6	.0	13.4
BUNCHGRASS MDWSNOTEL	5000	6/01/02	---	14.5	.0	9.7
CHICKEN CREEK	4060	5/31/02	0	.0	.0	.0
COMBINATION SNOTEL	5600	6/01/02	---	.0	.0	.0
COPPER BOTTOM SNOTEL	5200	6/01/02	---	.0	.0	.0
CORRAL PASS SNOTEL	6000	6/01/02	---	36.5	12.5	23.1
COUGAR MTN. SNOTEL	3200	6/01/02	---	11.3	.0	1.5
DALY CREEK SNOTEL	5780	6/01/02	---	.0	.0	.0
DEVILS PARK	5900	5/30/02	101	56.4	17.2	31.8
DISCOVERY BASIN	7050	5/28/02	4	1.0	.0	2.4
DOCK BUTTE AM	3800	6/01/02	---	67.0E	21.0	52.5
EASY PASS AM	5200	6/01/02	---	95.0E	29.0	73.3
ELBOW LAKE SNOTEL	3200	6/01/02	47	23.9	.0	19.8
EMERY CREEK SNOTEL	4350	6/01/02	---	.0	.0	.0
ENDERBY CAN.	5800	5/30/02	100	47.6	28.0	38.9
FISH LAKE SNOTEL	3370	6/01/02	18	7.6	.0	7.5
FLATTOP MTN SNOTEL	6300	6/01/02	---	49.1	14.3	36.5
FREEZEOUT CK. TRAIL	3500	5/30/02	0	.0	.0	--
FROHNER MDWS SNOTEL	6480	6/01/02	---	.0	.0	.7
GRAVE CRK SNOTEL	4300	6/01/02	---	.0	.0	.0
GREEN LAKE SNOTEL	6000	6/01/02	20	6.4	.0	6.6
GRIFFIN CR DIVIDE	5150	6/03/02	0	.0	--	--
GROUSE CAMP SNOTEL	5380	6/01/02	---	.0	.0	.2
HAND CREEK SNOTEL	5030	6/01/02	---	.0	.0	.0
HARTS PASS SNOTEL	6500	6/01/02	85	39.1	3.0	36.5
HELL ROARING DIVIDE	5770	5/30/02	38	18.9	.4	10.8
HERRIG JUNCTION	4850	5/31/02	35	19.1	.0	5.4
HIGH RIDGE SNOTEL	4980	6/01/02	0	.0	.0	5.0
HOODOO BASIN SNOTEL	6050	6/01/02	---	51.2	8.9	28.4
HUMBOLDT GLCH SNOTEL	4250	6/01/02	---	.9	.0	.0
JUNE LAKE SNOTEL	3200	6/01/02	---	32.3	.0	--
KRAFT CREEK SNOTEL	4750	6/01/02	---	.0	.0	.0
LOLO PASS SNOTEL	5240	6/01/02	29	13.1	.0	4.9
LONE PINE SNOTEL	3800	6/01/02	---	41.8	4.4	18.4
LOOKOUT SNOTEL	5140	6/01/02	---	27.7	.0	8.0
LOST HORSE SNOTEL	5000	6/01/02	0	.0	.0	1.1
LOST LAKE SNOTEL	6110	6/01/02	---	65.7	11.2	41.5
LUBRECHT SNOTEL	4680	6/01/02	---	.0	.0	.0
LYMAN LAKE SNOTEL	5900	6/01/02	---	76.9	21.5	50.8
MEADOWS CABIN	1900	5/30/02	0	.0	.0	--
MEADOWS PASS SNOTEL	3240	6/01/02	---	12.3	.0	.9
MICA CREEK SNOTEL	4750	6/01/02	---	9.1	.0	.0
MORSE LAKE SNOTEL	5400	6/01/02	---	33.4	7.4	--
MOSES MTN SNOTEL	4800	6/01/02	---	.0	.0	.1

SNOW COURSE	ELEVATION	DATE	SNOW DEPTH	WATER CONTENT	LAST YEAR	AVERAGE 1971-00
MOSQUITO RDG SNOTEL	5200	6/01/02	---	21.2	.0	11.0
MOUNT BLUM AM	5800	6/01/02	---	90.0E	27.0	68.1
MOUNT CRAG SNOTEL	4050	6/01/02	45	19.9	.0	--
MT. KOBAU CAN.	5500	5/29/02	22	9.0	.0	5.0
MOUNT GARDNER SNOTEL	2860	6/01/02	---	.0	.0	.0
N.F. ELK CR SNOTEL	6250	6/01/02	---	.0	.0	.6
NEW HOZOMEEN LAKE	2800	5/29/02	0	.0	.0	--
NEZ PERCE CMP SNOTEL	5650	6/01/02	---	.0	.0	.3
NOISY BASIN SNOTEL	6040	6/01/02	---	33.6	11.5	30.1
NORTH FORK JOCKO	6330	5/31/02	68	37.7	10.9	--
OLALLIE MDWS SNOTEL	3960	6/01/02	---	55.5	13.0	31.8
OPHIR PARK	7150	6/02/02	2	.9	.0	--
PARADISE PARK SNOTEL	5500	6/01/02	---	84.6	41.5	61.6
PARK CK RIDGE SNOTEL	4600	6/01/02	51	30.8	.0	11.5
PETERSON MDW SNOTEL	7200	6/01/02	---	1.1	.0	2.7
PIGTAIL PEAK SNOTEL	5900	6/01/02	91	45.0	12.9	39.9
PIKE CREEK SNOTEL	5930	6/01/02	---	15.6	.0	7.3
POPE RIDGE SNOTEL	3540	6/01/02	---	.0	.0	.0
POTATO HILL SNOTEL	4500	6/01/02	---	7.9	.0	2.7
QUARTZ PEAK SNOTEL	4700	6/01/02	---	.0	.0	.0
RAINY PASS SNOTEL	4780	6/01/02	---	35.5	1.2	24.3
REX RIVER SNOTEL	1900	6/01/02	---	22.3	.0	6.1
ROCKER PEAK SNOTEL	8000	6/01/02	---	10.2	2.1	11.7
SADDLE MTN SNOTEL	7900	6/01/02	---	15.8	.0	16.3
SALMON MDWS SNOTEL	4500	6/01/02	0	.0	.0	.0
SASSE RIDGE SNOTEL	4200	6/01/02	---	18.9	.0	5.9
SAVAGE PASS SNOTEL	6170	6/01/02	41	17.6	.0	10.4
SCHREIBERS MDW AM	3400	6/01/02	---	58.0E	12.0	41.4
SHEEP CANYON SNOTEL	4050	6/01/02	---	28.7	.0	13.7
SHERWIN SNOTEL	3200	6/01/02	---	.0	.0	.0
SILVER STAR MTN CAN.	5600	5/29/02	65	33.3	13.8	16.1
SKALKAHO SNOTEL	7260	6/01/02	---	13.8	.0	14.6
SKOOKUM CREEK SNOTEL	3920	6/01/02	---	28.7	.0	--
SOURDOUGH GULCH SNTL	4000	6/01/02	0	.0	.0	--
SPENCER MDW SNOTEL	3400	6/01/02	---	12.8	.0	3.0
SPIRIT LAKE SNOTEL	3100	6/01/02	---	.0	.0	--
SOURDOUGH GULCH SNTL	4000	6/01/02	0	.0	.0	--
STAHL PEAK SNOTEL	6030	6/01/02	---	43.5	7.6	28.0
STAMPEDE PASS SNOTEL	3860	6/01/02	---	41.2	5.6	18.6
STEVENS PASS SNOTEL	4070	6/01/02	---	24.2	.0	9.0
STRYKER BASIN	6180	5/31/02	63	33.8	4.5	19.4
SUNSET SNOTEL	5540	6/01/02	---	14.8	.0	13.5
SURPRISE LKS SNOTEL	4250	6/01/02	---	37.3	1.9	19.0
THUNDER BASIN	4200	5/29/02	48	22.6	--	10.0
TINKHAM CREEK SNOTEL	3000	6/01/02	---	18.3	.0	2.9
TOUCHET SNOTEL	5530	6/01/02	15	5.8	.0	2.5
TROUGH #2 SNOTEL	5310	6/01/02	0	.0	.0	.0
TV MOUNTAIN	6800	5/31/02	18	8.2	.0	--
TWELVEMILE SNOTEL	5600	6/01/02	---	.0	.0	.4
TWIN LAKES SNOTEL	6400	6/01/02	---	30.6	.0	22.3
UPPER WHEELER SNOTEL	4400	6/01/02	---	.0	.0	.0
WARM SPRINGS SNOTEL	7800	6/01/02	---	16.9	5.2	17.0
WATSON LAKES AM	4500	6/01/02	---	75.0E	22.0	57.4
WELLS CREEK SNOTEL	4200	6/01/02	40	18.9	.0	--
WHITE PASS ES SNOTEL	4500	6/01/02	---	8.2	.0	5.6
WHITE ROCKS MTN CAN.	7200	5/31/02	31	15.4	.0	6.6



June 1, 2002 -
Snowpack, Precipitation and Reservoir
Conditions at a Glance
(Water Year = October 1, 2001 - Current Date)
Percent of Average
275
250
225
200
175
150
125
100
75
50
25
0
188
145
134
160
193
127
77
128
184
192
268
133
411
Spokane
Colville
Okanogan
Wenatchee
Upper Yakima
Lower Yakima
Walla Walla
Lower Snake
Cowlitz-Lewis
White-Green
Central Puget
North Puget
Olympic
May Prcipitation
Water-Year Precipitation
May Reservoir
Water-Year Snowpack

USDA NRCS

Natural Resources Conservation Service

Washington State

Snow, Water and Climate Services

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Helpful Internet Addresses

NRCS Snow Survey and Climate Services Homepages

Washington:
http://www.wa.nrcs.usda.gov/snow/

Oregon:
http://www.or.nrcs.usda.gov/snow/

Idaho:
http://idsnow.id.nrcs.usda.gov

National Water and Climate Center (NWCC):
http://www.wcc.nrcs.usda.gov

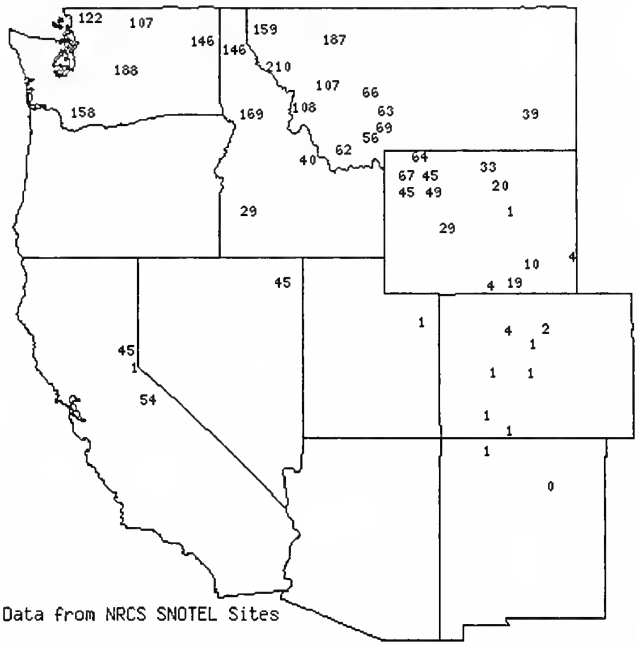
NWCC Anonymous FTP Server:
ftp.wcc.nrcs.usda.gov

USDA-NRCS Agency Homepages

Washington:
http://www.wa.nrcs.usda.gov/nrcs

NRCS National:
http://www.ftw.nrcs.usda.gov

Basin Average Snow Water Content. (% of Average.)



Report Date:

JUNE 6 , 2002

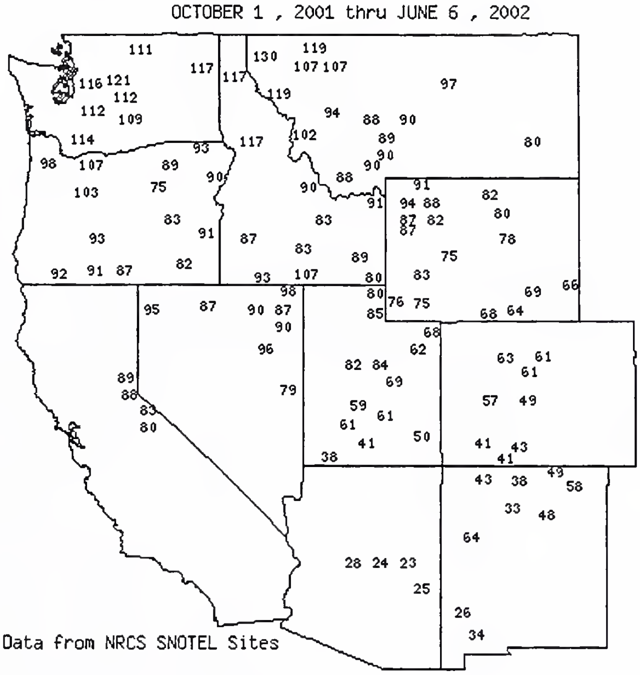
Provisional Data
Based on Mountain Data from NRCS SNOTEL Sites

Data provided by
Water and Climate Center
National Resource Conservation Service
Portland, Oregon

Western Regional Climate Center
Desert Research Institute
Reno, Nevada

Basin Average Precipitation. (% of Average.)

OCTOBER 1 , 2001 thru JUNE 6 , 2002



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GLACIER PAGE 2002

North Cascades National Park
Glacier Monitoring Program

The National Park Service began monitoring glaciers in North Cascades National Park in 1993. Goals for this program and additional data can be found at North Cascades National Park home page at http:/www.nps.gov/noca/massbalance.htm.

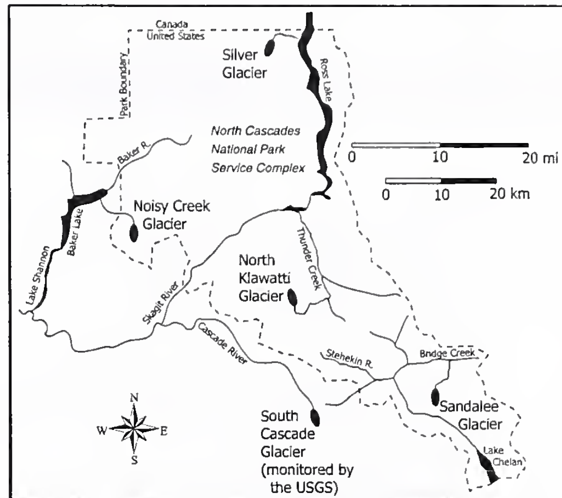

Figure 1. Glaciers monitored in North Cascades N.P.S. Complex.

The four glaciers monitored are located at the headwaters of four park watersheds, each with large hydroelectric operations (Figure 1). The glaciers represent a range in elevation from 8500 to 5700 feet, and a range in climatic conditions from maritime to continental. Methods include at least two visits annually to each glacier to measure winter accumulation and summer melt. Measurements are taken at a series of points down the centerline of each glacier (Table 1), then integrated across the entire glacier surface to determine mass balance for the entire glacier. Glaciers east of the hydrologic crest of the park (Silver and Sandalee) have recently had more positive mass balances than the west-side glaciers (Noisy, North Klawatti, South Cascade) due to their higher elevations, and north aspects (Figure 2). We are entering our tenth year of this program. In addition to the accumulation and ablation measurements each glacier will be remapped to quantify terminus and surface elevation changes. A 10-year summary will be published next year.

Table 1. Glacier:	Elevation (feet)	Average Accumulation (inches W.E.)	2002 Accumulation (inches W.E.)	2002 Percent of Average
Noisy Creek	**Entire Glacier**	**125**	**141**	**113**
	6130	134	146	109
	6040	131	149	113
	5900	127	140	111
	5760	117	132	113
	5630	117	137	117
Silver	**Entire Glacier**	**103**	**125**	**122**
	8430	125	167	133
	7940	112	154	138
	7560	128	135	105
	7040	76	104	137
North Klawatti	**Entire Glacier**	**121**	**137**	**113**
	7665	128	151	118
	7400	129	138	107
	7000	129	134	104
	6520	110	128	116
	6240	100	122	121
Sandalee	**Entire Glacier**	**128**	**137**	**107**
	7380	120	127	105
	7085	134	150	111
	6757	119	146	123
	6560	144	137	95

Table 1 presents this spring's winter accumulation data, along with average values and percent of the 10-year average. The 2002 snow depths were measured between April 29 and May 1 on the four glaciers. Ice layers and cold temperatures within the snowpack made probing difficult for the stations in gray text. These data are suspect and may be revised after a July visit. Snow water equivalent is determined using an assumed density of 0.5. Accumulation generally increases with elevation, but this winter, wind and avalanching were responsible for significantly redistributing snow. This year's accumulation values are above the ten-year average, and are the third highest in the last 10 years (behind the winters of 96/97 and 98/99).

Estimates of glacial contribution to runoff for three watersheds are based on the mass balance measurements and GIS analysis to determine glacier area within 165 ft elevation bands (Table 2). Glaciers reduce the variation of flow in these watersheds by providing meltwater from ice in dry/warm years, and by storing water in wet/cool years. Glacial contribution to streamflow in these watersheds varies by as much as 100% annually. Magnitude of glacial contribution to streamflow is large, but varies by the amount of glacial cover in each watershed. Thunder Creek is 13% glaciated, while Baker River and Stehekin River are 6% and 3%, respectively (Post and others, 1971).

Relative importance of glacial contribution to streamflow increases from west to east. For example, glaciers annually contribute a higher percentage of meltwater to streamflow in the Stehekin watershed than in the Baker, despite the fact that the Baker is more glaciated. This is due to lower snowfall east of the hydrologic crest of the North Cascades. In this high accumulation year we anticipate that glacial contribution to summer runoff will be below average in these watersheds.

	Mean Glacial Runoff	Range of Glacial Runoff		Percent Glacial Runoff to Total Summer Runoff	
		Minimum	Maximum	Minimum	Maximum
Noisy Creek Glacier	1.6	1.1	2.1	---	---
Baker River Watershed	74	51	93	6	14
North Klawatti Glacier	3.9	2.8	4.8	---	---
Thunder Creek Watershed	102	80	135	23	45
Sandalee Glacier	0.4	0.4	0.5	---	---
Stehekin River Watershed	68	54	91	6	16

Table 2. Glacial contribution to summer stream flow (May 1 to Sept. 30) for three watersheds. Runoff units are thousands of acre-feet. Data from 1993-2001 except the Sandalee Glacier and Stehekin River Watershed (1995-2001).

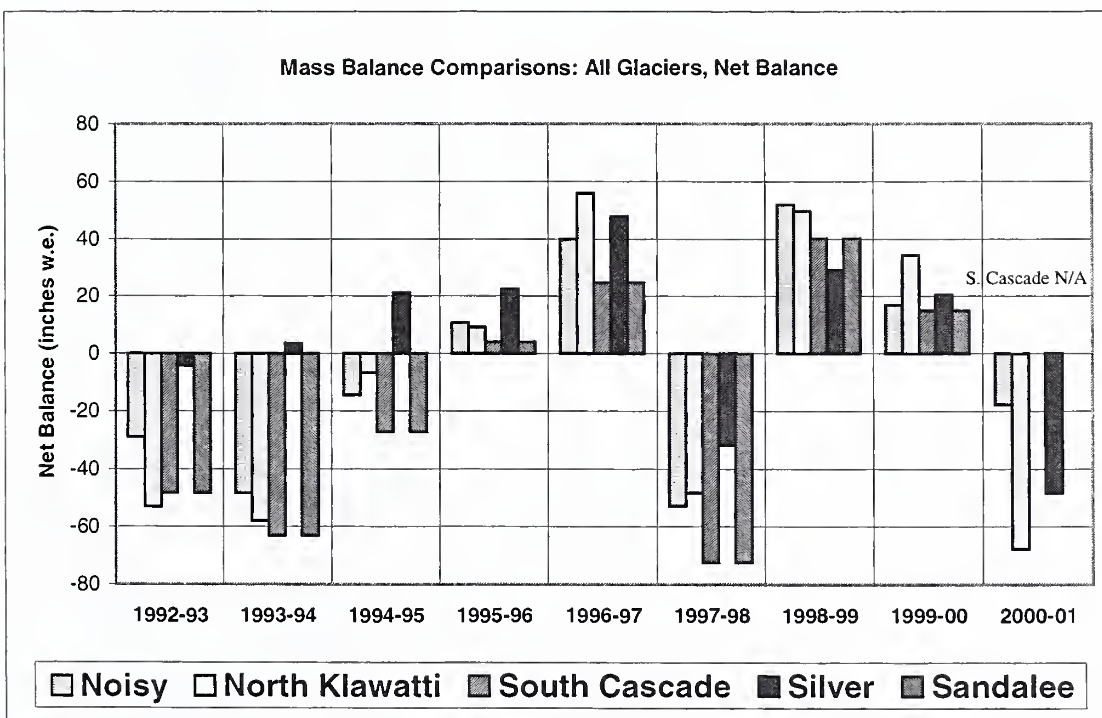

Figure2. Net annual mass balance for the five glaciers monitored in the North Cascades

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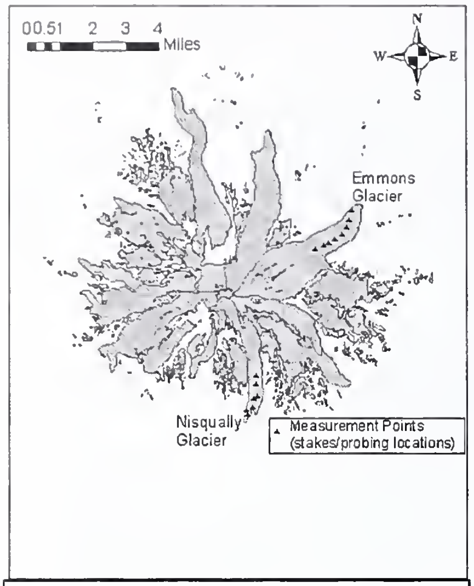

Figure 1. Glacier cover of Mount Rainier and locations of monitored glaciers.

	Elevation Feet	Accumulation inches w.e.	Standard Deviation	N
Emmons Glacier	7000	52	20	8
	6600	71	35	13
	6206	91	19	5
	6150	63	24	18
	6020	61	14	5
	5770	58	24	15
	5412	55	30	6
	5350	45	26	10
Nisqually Glacier	6900	122	8	2
	6610	102	19	2
	6190	108	16	9
	5965	75	65	5
	5642	112	16	9
	5250	117	26	8

Table 1. Accumulation on Mount Rainier Glaciers, Spring 2002. Determined from probing snow depth on each elevation contour N times. Standard deviation represents the variation in snow depths from changes in the underlying ice surface topography and drifting.

This year the North Cascades National Park glacier monitoring team began developing methods for monitoring mass balance annually on Mount Rainier glaciers. This program is a cooperative venture between Mount Rainier National Park, the US Geological Survey, and North Cascades National Park. The program includes annual air photography of the mountain and field measurements on Nisqually Glacier and Emmons Glacier. In late April we measured bulk density of the snowpack, probed snow depths, and placed ablation stakes on the lower Nisqually (April 23) and Emmons (April 25) glaciers below 8000 feet. Bulk density of the snowpack on Nisqually Glacier at 5642 feet was 0.48. On Emmons Glacier at 6150 feet the density was 0.57. Accumulation was quite variable on the lower glacier surfaces due to uneven topography of the underlying ice surface and wind drifting. Probing was extremely difficult on the upper Nisqually Glacier due to ice layers and our probe freezing into the snowpack.

Accumulation (Table 1) shows little or no correlation to elevation for Nisqually Glacier, but shows an increasing trend to ~6200 feet and decreasing trend above on Emmons. Four ablation stakes were placed on Nisqually Glacier at 6900, 6610, 6190, and 5642 feet. Three stakes were placed on Emmons Glacier at 6600, 6150, and 5770 feet. We will return in mid June to check ablation and place an additional stake near the terminus of each glacier. In addition we will probe snow depth higher on the mountain. On a fall visit (late September/early October) we will record final ablation measurements from the stakes.

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The Following Organizations Cooperate with the Natural Resources Conservation Service in Snow Survey Work*:

Canada	Ministry of Sustainable Resources Snow Survey, River Forecast Centre, Victoria, British Columbia
State	Washington State Department of Ecology Washington State Department of Natural Resources
Federal	Department of the Army Corps of Engineers U.S. Department of Agriculture Forest Service U.S. Department of Commerce NOAA, National Weather Service U.S. Department of Interior Bonneville Power Administration Bureau of Reclamation Geological Survey National Park Service Bureau of Indian Affairs
Local	City of Tacoma City of Seattle Chelan County P.U.D. Pacific Power and Light Company Puget Sound Power and Light Company Washington Water Power Company Snohomish County P.U.D. Colville Confederated Tribes Spokane County Yakama Indian Nation Whatcom County Pierce County
Private	Okanogan Irrigation District Wenatchee Heights Irrigation District Newman Lake Homeowners Association Whitestone Reclamation District

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CONSERVATION OF WATER BEGINS WITH THE SNOW SURVEY

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